

REMARKS

This reply encompasses a bona fide attempt to overcome the rejections raised by the Examiner and presents amendments as well as reasons why the applicants believe that the claimed invention is novel and unobvious over the closest prior art of record.

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Claim Status

Claims 1-40 were presented for examination. Claims 29-40 have been withdrawn from consideration. The provisional election of Group I, claims 1-28, made on 01 July 2004 is hereby affirmed. Claims 1-28 were rejected. Claim 21 was objected. Claims 1 and 21 are
10 amended herein. No new matter is introduced. Support for the amendments to the claims can be found in the Specification as originally filed, particularly on page 22, lines 17-19. No claim is newly added. By this Amendment, claims 1-28 are pending.

Regarding the Specification

15 The Specification was objected to because of a minor informality on page 23, line 24. The required correction is submitted herewith. Withdrawal of the objection to the Specification is therefore earnestly requested.

Regarding Claim Objection

20 Claim 21 was objected to because of a minor informality on line 4. The required correction is submitted herewith. Withdrawal of the objection to the claim is therefore earnestly requested.

Regarding Claim Rejections

Independent claim 1 was rejected under 35 U.S.C. § 102(e) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as being obvious over Paul *et al.* (U.S. Patent No. 6,086,243, hereinafter referred to as the EMM – Electrokinetic Microfluid Mixer). The
5 rejections are respectfully traversed. Reconsideration of the patentability of the claimed invention, hereinafter referred to as the EKI Micromixer, is respectfully requested in view of the following remarks.

The EKI Micromixer as claimed in claim 1 is distinguishable from the EMM at least because
10 claim 1 specifically recites, among others, inducing an electrokinetic flow **instability**. The EMM induces an electroosmotic flow (EOF) to **stir** the liquid in a process called “chaotic advection”. In the EMM, EOF pulls and folds the interface between two mixers by the action of the disclosed liquid induction device.

15 In contrast, the EKI Micromixer as claimed in claim 1 induces and generates an **electrokinetic instability**, which is a self-forcing method of mixing. That is, the EKI Micromixer is not “stirring” the liquid like the EMM does, but rather creating conditions where **flow instabilities** occurs and the action of these **instabilities** stir the liquid – this subtle difference is very important. As an example, the EKI Micromixer works even in the
20 absence of EOF, while the EMM cannot. Further discussion regarding the differences between the EMM and the EKI Micromixer can be found in the Specification, pages 8 and 12-13, of the above-identified application. Applicants respectfully submit that the EKI

Micromixer as claimed in claim 1 is **not** the same as the EMM and is patentable over the EMM under 35 U.S.C. § 102(e).

Claim 1 was also rejected under 35 U.S.C. § 103(a) as being obvious over the EMM (Paul *et al.*). The rejections are respectfully traversed.

When applying 35 USC 103, the following tenets of patent law must be adhered to:

- (A) The claimed invention must be considered as a whole;
- (B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination;
- (C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention; and
- (D) Reasonable expectation of success is the standard with which obviousness is determined.

Hodosh v. Block Drug Co., Inc., 786 F.2d 1136, 1143 n.5, 229 USPQ 182, 187 n.5 (Fed. Cir. 1986). *See also*, MPEP 2141.

It is respectfully submitted that, at least according to (B), the EKI Micromixer as claimed in claim 1 is unobvious over the EMM. As a whole, the EMM lacks teaching on EKI. The Office action did not provide a proper motivation, and the EMM does not suggest the desirability, to combine or modify the EMM so to arrive at an invention as set forth in claim 1. Consequently, a *prima facie* case of obviousness has not been established. Withdrawal of the rejections under 35 U.S.C. § 103(a) is therefore earnestly requested.

It is further respectfully submitted that, at the time the invention was made, the EKI Micromixer was not in the general knowledge of one of ordinary skill in the art. The inventors first documented the existence, character, and dynamics of this electrokinetic instability and duly disclosed in the above-identified application the best way to make and use these flow instabilities in a new microfluidic mixer especially designed therefor. None of the applied references teaches or suggests the same.

Claim 1 was again rejected under 35 U.S.C. § 102(e) as being anticipated by Ahn *et al.* (U.S. Patent Application Publication No. 2002/0023841 A1, hereinafter referred to as the EHD – Electrohydrodynamic Convection Microfluidic Mixer). The rejections are respectfully traversed. Reconsideration is respectfully requested in view of the following remarks. It is respectfully submitted that this second 35 U.S.C. § 102 rejection was improper and should be withdrawn [MPEP 2131.01].

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The EKI Micromixer as claimed in claim 1 is distinguishable from the EHD at least because the EKI Micromixer lacks an important restriction that the EHD must have. Paragraph [0045] from Ahn *et al.* discloses that the electrodes are disposed across a microfluidic channel within 200 μm of each other and are arranged in such a manner that the electrodes are capable of providing a “transverse field” within the fluids on the channel. One skilled in the art would have readily recognized that this is very, very specific and difficult to build.

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In contrast, the EKI Micromixer can work with electrodes located as much as a several centimeters away and the EKI can be initiated with predominantly **axial** (not only transverse) fields. In fact, as FIG. 4 illustrates, the electrodes of the EKI Micromixer are at the ends of long thin channels. This arrangement is important because microfabricated, closely-spaced
5 electrodes within a microfluidic channel would be very restrictive.

The EKI Micromixer works well with either DC or AC. This is unlike the EHD which quickly generates bubbles *inside the channel* if DC is applied. These bubbles interrupt mixer operation and interrupt flow. Contrastingly, since the EKI Micromixer uses end-channel
10 electrodes (immersed in end-channel liquid reservoirs, as shown in FIG. 4), bubbles are free to float up and out of the chip. The EHD bubbles cannot do this.

Having distinguished Paul *et al.* (the EMM) and Ahn *et al.* (the EHD), reliance is placed on *In re Fine*, 5 USPQ 2d 1596, 1600 (Fed. Cir. 1988) and *Ex parte Kochan*, 131 USPQ 204
15 (Bd. App. 1960) for the allowance of dependent claims 2-16 since they differ in scope from their parent independent claim 1 which is submitted to be patentable.

Independent claim 17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ahn *et al.* in view of Bek (U.S. Patent No. 5,785,831). The rejections are respectfully traversed.
20 Reconsideration is respectfully requested in view of the following remarks.

As submitted above, Ahn *et al.* teach a different invention. Claim 17 specific recites that an electrokinetic flow instability (EKI) is induced **in a mixing chamber** to effect rapid mixing

of an initially heterogeneous solution [Spec. page 22, lines 17-19]. The EHD does not have a mixing chamber where electrokinetic instability is largely confined to occur. Bek does not fill the void of Ahn *et al.*

5 Moreover, at the time the invention was made, one of ordinary skill in the art, upon reading and understanding Ahn *et al.* and Bek, would **NOT** have been motivated to re-positioning the electrodes at the ends of side channels, as the examiner has alleged. There was no theoretical support and no reasonable expectation of success for the alleged modification. In fact, such a modification is contradictive to the teaching of Ahn *et al.* [Paragraphs [0071-0084]; FIG. 5].

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Furthermore, neither Ahn *et al.* nor Bek suggests the desirability and thus the obviousness of making the alleged combination. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in

15 the knowledge generally available to one of ordinary skill in the art. *See, In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

Absent such a showing in the prior art and lacking evidence supporting that the EKI Mixer

20 was in the knowledge generally available to one of ordinary skill in the art at the time of the invention, the Examiner has impermissibly used the applicant's teaching to hunt through the prior art for the claimed elements and combine them as claimed (see *In re Vaeck*, 947 F. 2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991); *In re Bond*, 910 F. 2d 831, 15 USPQ 2d 1566 (Fed.

Cir. 1990); *In re Laskowski*, 871 F. 2d 115, 117, 10 USPQ 2d 1397, 1398 (Fed. Cir. 1989)). Therefore, the Examiner has **not** established a *prima facie* case of obviousness (*ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F. 2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984)).

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Reliance is placed on *In re Fine*, 5 USPQ 2d 1596, 1600 (Fed. Cir. 1988) and *Ex parte Kochan*, 131 USPQ 204 (Bd. App. 1960) for the allowance of dependent claims 18-28 since they differ in scope from their parent independent claim 17 which is submitted to be patentable.

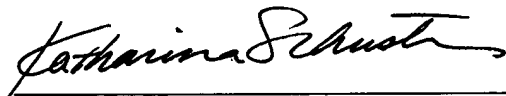
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Conclusion

For the foregoing reasons, it is respectfully submitted that the present invention as claimed in claims 1-28 recites subject matter not reached by the applied art under 35 U.S.C. §§ 102 and/or 103 and therefore should be allowed. Accordingly, Applicants respectfully submit that

15 the present application is in a condition for allowance.

Respectfully submitted,



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